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None

(58) Field of search
F2D

(54) Pulley assembly

(57) A V-belt pulley assembly comprises two pulley halves (6, 8) for a continuously variable V-belt transmission in which the pulley halves are pressed against the belt in dependence on torque and gearing. A respective presser ring (14, 15) is associated with each of the pulley halves (6, 8) and is connected to that pulley half to be fixed in axial direction and rotatable. The two rings (14, 15) are articulatedly connected together by way of two or more tie rods (16). Two entraining pins (17, 18), which are fastened rigidly and parallelly to an input shaft (1) of the assembly, are arranged at each of the rings. Elongate openings (19, 20) with abutment surfaces at both ends for the free end portions of the entraining pins are arranged in regions of the pulley halves opposite the pins. The arrangement allows the rods (16) to generate a force on the belt in both directions of rotation.

Fig. 1.

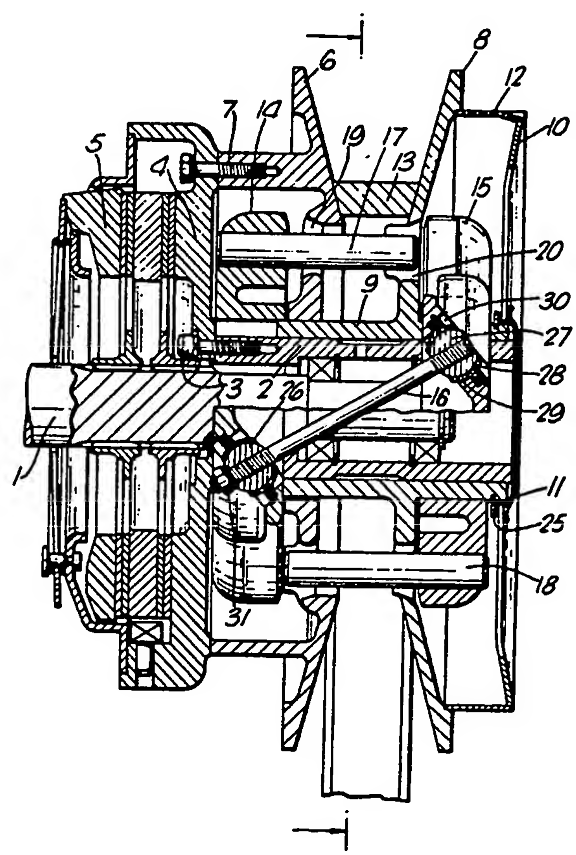

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Fig. 1.

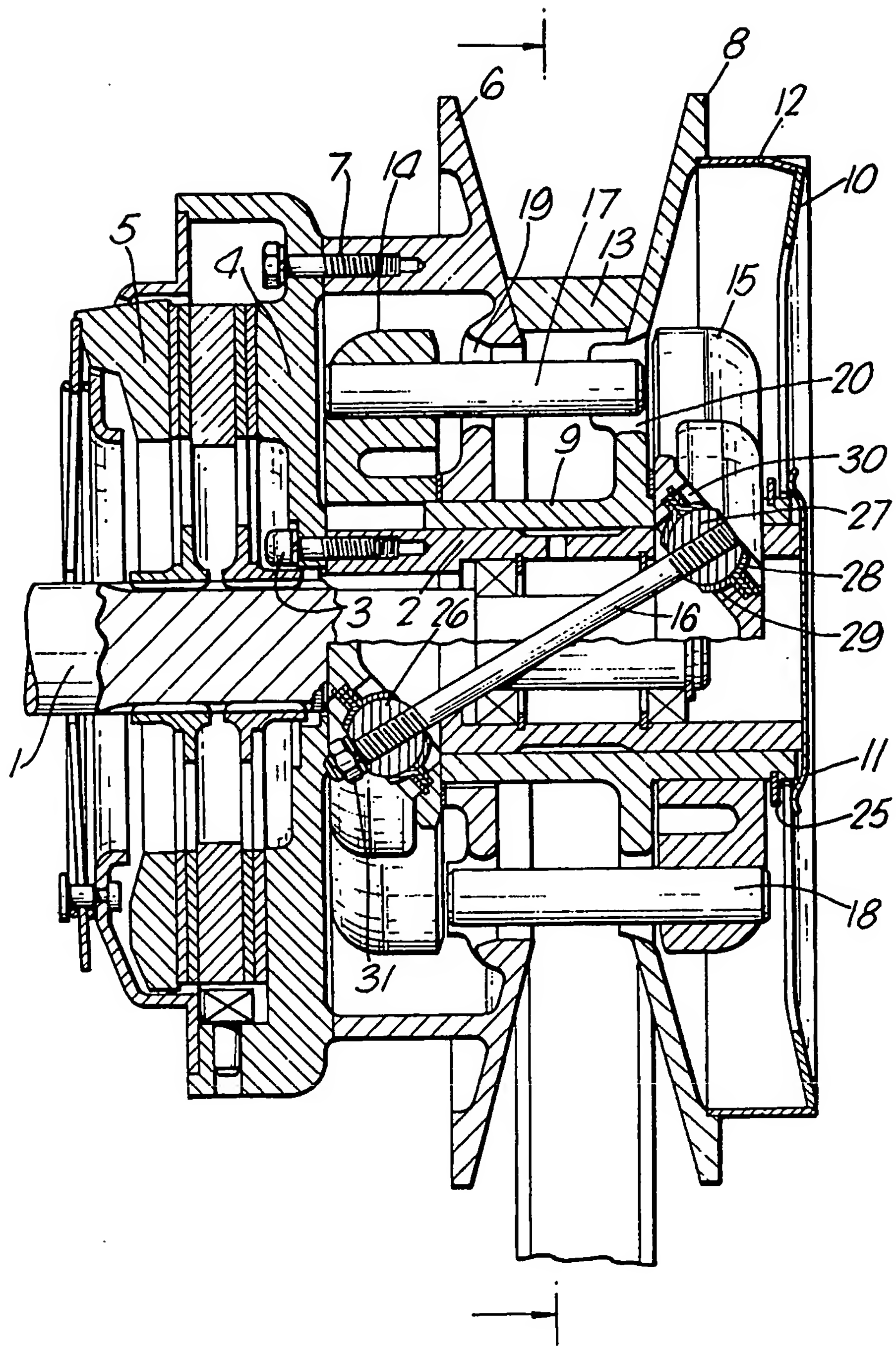


Fig. 2.

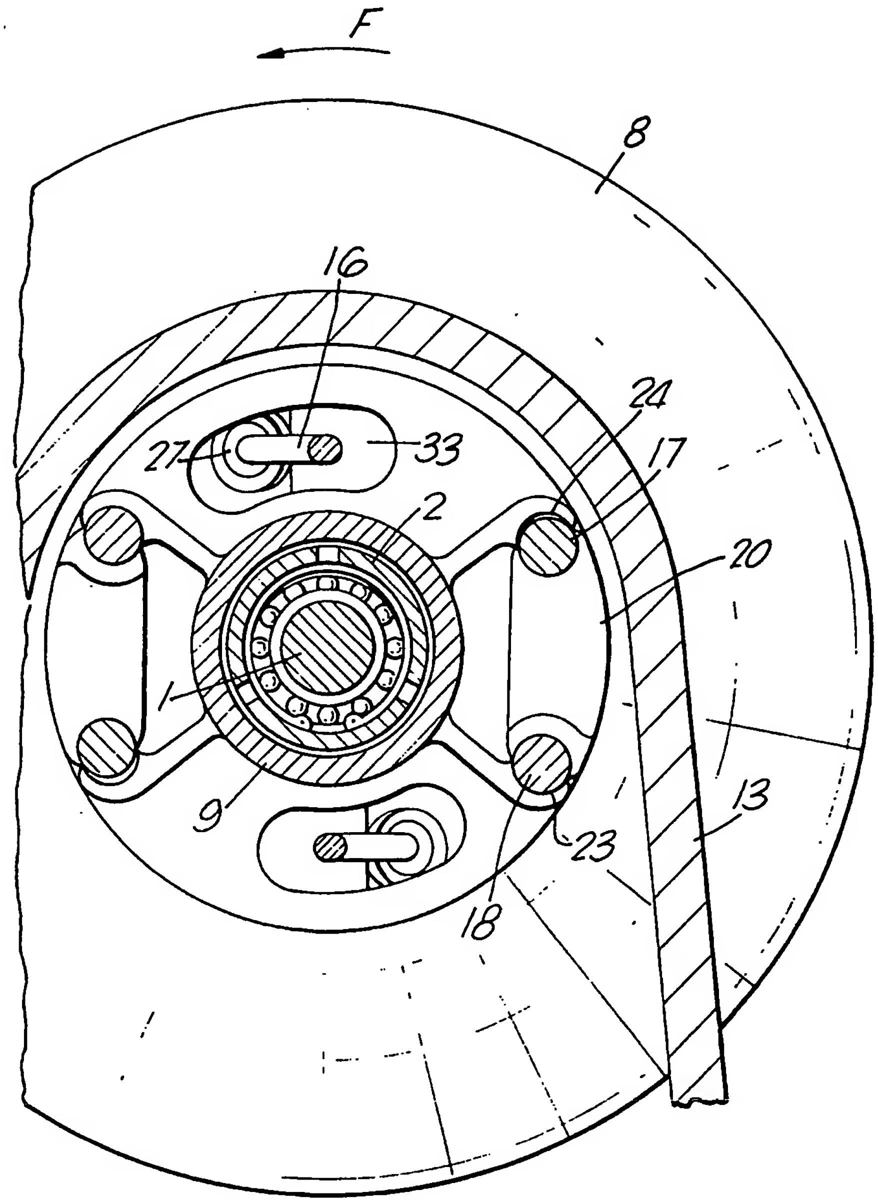
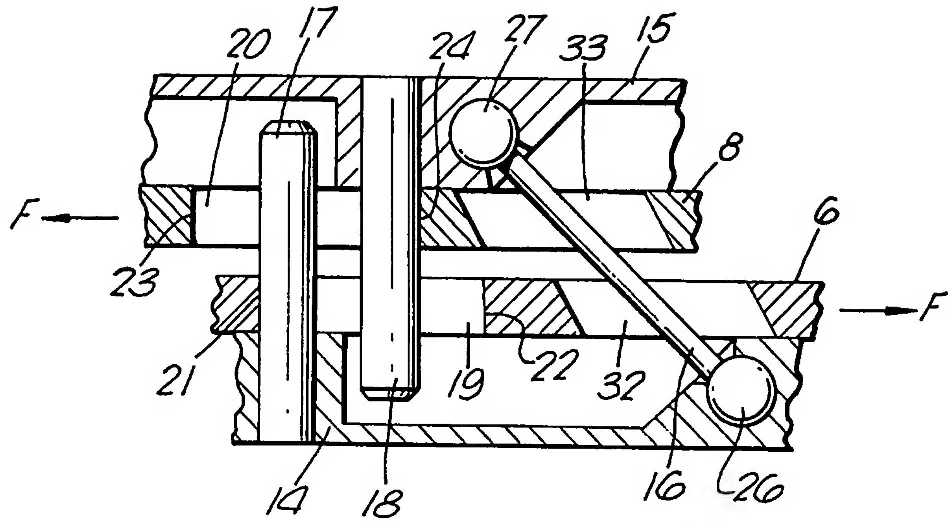


Fig. 3.


20
17
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27
33
15
8
6
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14
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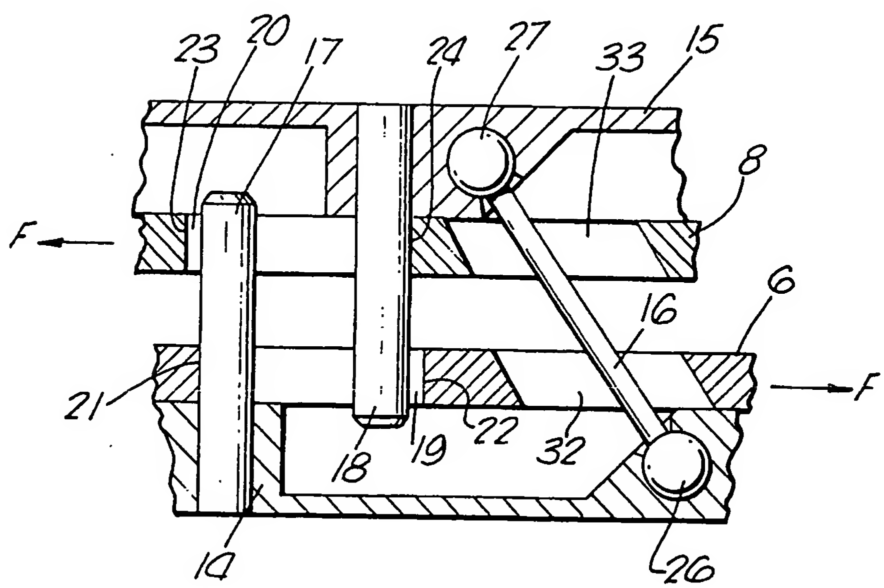
16
26

Fig. 4.


23
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33
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8
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16
F
F
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22
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14
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Fig. 5.

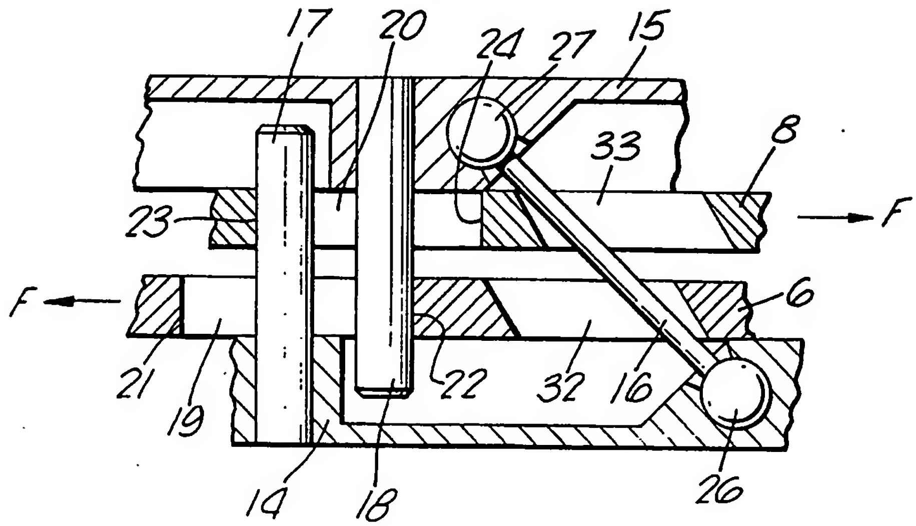
17
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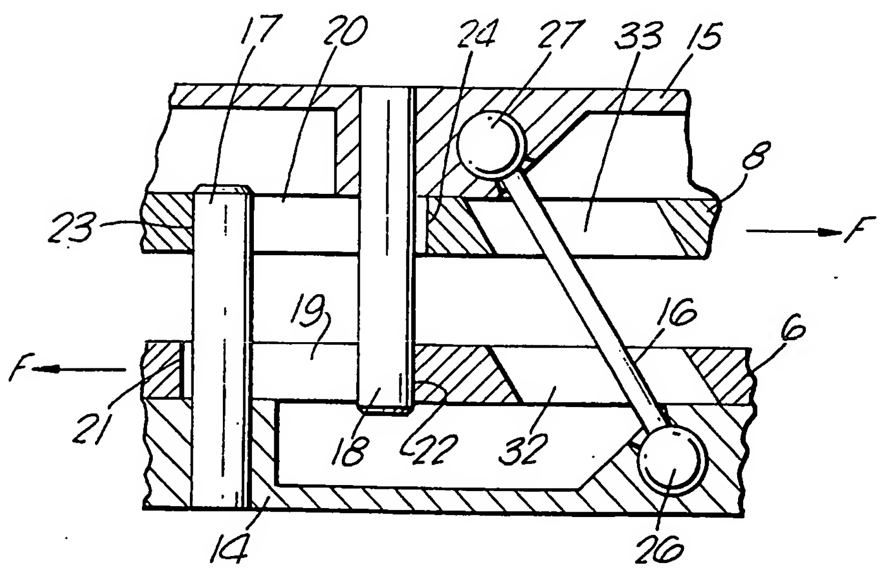
Fig. 6.


17
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SPECIFICATION

Pulley assembly

The present invention relates to a V-belt pulley assembly, especially for a continuously variable transmission wherein, for example, V-belt pulley halves can be pressed in dependence on torque and gearing against a V-belt for the transmission of driving power with alternating direction of torque such as in the drive of an automotive agricultural machine.

Continuously variable V-belt transmissions with belt presser devices dependent on torque are known in diverse constructions. For example, DE-PS 24 22 221 discloses a three-shaft traction gear for an agricultural machine, in which a settable V-belt pulley half is automatically resettable on an increase in torque by way of a cam control in axial direction to increase its running circle diameter and thus the belt tension. For this purpose, dog elements are arranged co-axially at equal spacing around the circumference of the pulley half and have numerous interengaging dogs, the surfaces of which extend obliquely with respect to the dog axis and radially inwards. These surfaces rest against oppositely disposed surfaces of the corresponding dog.

These known dog or cam pulley controls, which require a considerable amount of space in the axial direction, are subject to high wear. This disadvantage is noticeable in, for example, harvester threshers which are exposed to aggravated conditions of use, such as strong dust loading, changing weather influences and high loads. Due to wear, inaccuracies at the dog or cam pulley surfaces arise and lead to a change in the presser characteristic and to an appreciable increase in the coefficient of friction. This in turn leads to the regulating characteristic of the V-belt gear becoming flatter and lowering the additional pressing of the pulley halves against the V-belt in dependence on torque. The consequence is increased slip which, on transmission of high power, leads to the slipping of the V-belt. Due to the strong heating connected therewith, damage or complete destruction of the belt results after a relatively short time.

Since the exchangeable construction of the parts subject to wear does not eliminate the basic disadvantages of these constructions, it has been attempted to reduce the fault susceptibility of the V-belt transmission through other measures. One possibility of achieving this by reducing the loading of the dog or cam pulley surfaces and thereby reducing wear and the rise in the coefficient of friction is described in DE-PS 26 29 279. In this construction, the contact pressure to be generated is exerted to the extent of about two thirds by a biassed compression spring and about one third by the V-tracks running up one on the other. A disadvantage of this presser device is that on the one hand the actual effect of the pressing in dependence on torque is substantially reduced by a constant presser force and on the other hand slipping of the V-belt with its disadvantageous consequences occurs at high loadings due to the inevitably flat rise of the pressing in dependence on torque and consequent increase in the coefficient of friction.

In DD-PS 103 785 there is disclosed a continuously variable thresher drum drive for harvester threshers with pressing of the V-belt in dependence on torque, in which the pulley halves are connected by means of entraining elements arranged obliquely to the axis of rotation. The entraining elements are constructed as rigid tie rods mounted in ball pivots in the pulley halves. In this construction, the equipment for pressing in dependence on torque and gearing acts in substantially only one direction of drive, since only a relatively weak compression spring acts on the axially displaceable pulley half in the opposite direction. As a consequence, the transmitted torque is only very small. For this reason, this construction is not usable for the drive of automotive agricultural machines.

It would thus be desirable to provide presser equipment which is dependent on torque and low in wear and maintenance, a torque transmission being possible with like magnitude in both directions and with the same constructional elements while requiring a relatively small axial constructional space.

According to the present invention there is provided a V-belt pulley assembly comprising two relatively movable pulley halves defining a groove therebetween for a V-belt, and means for exerting on the pulley halves a torque-dependent force tending to axially displace the pulley halves relative to each other, the force-exerting means comprising a respective presser ring connected to each pulley half to be rotatable relative thereto but secure against axial displacement relative thereto, at least two tie rods so pivotably connected to and intercoupling the rings as to translate relative rotation thereof into relative axial displacement of the rings and of the pulley halves, and a respective pair of entraining pins which are rigidly connected to each ring to extend parallel to the axis of the pulley halves, the pins extending in elongate openings in the pulley halves and the openings being bounded by abutment surface portions engageable by the pins.

In a preferred embodiment, the pulley halves at the power take-off end are connected with each other by means of two or more rigid tie rods which are mounted in ball pivots and arranged obliquely to the axis of rotation, a respective presser ring being associated with each of the pulley halves. The presser rings are connected with the pulley halves to be

fixed in axial direction and rotatable and the two rings are articulatedly connected with each other by way of the tie rods. Two entraining pins, which are fastened rigidly and parallelly to an input shaft, are arranged at each of the presser rings and elongate openings with abutment surfaces for the free ends of the entraining pins are arranged in the regions of the pulley halves opposite the pins.

Preferably, the openings are so arranged that two entraining pins -one of each presser ring—project into these together and simultaneously. A shape-locking or mechanical rotational connection is provided present between the pulley halves and the rings by the entraining pins. The two rings can have the same construction. Both end portions of each tie rod are preferably provided with a thread, and balls are threaded on these.

An assembly embodying the invention makes possible a pressing in dependence on torque and gearing for the V-belt of a continuously variable V-belt transmission so that high power is transmissible in both directions of torque. The assembly may exhibit a low wear rate even under aggravated conditions of use, requiring little maintenance and operating reliably for all loadings. It needs a relatively small axial constructional space and may be capable of economic manufacture.

An embodiment of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is an axial sectional view of a driven V-belt pulley assembly of a continuously variable V-belt gear;

Fig. 2 is a cross-section on the section line in Fig. 1;

Fig. 3 is a sectional plan view of part of the assembly showing components loaded in the principal torque direction and with small spacing of pulley halves of the assembly;

Fig. 4 is a view similar to Fig. 3 but with a large spacing of the pulley halves;

Fig. 5 is a view similar to Fig. 3 but showing the components loaded in the opposite torque direction and with a small spacing of the pulley halves; and

Fig. 6 is a view similar to Fig. 5 but with a large spacing of the pulley halves.

Referring now to the drawings, there is shown an input shaft 1 of the drive transmission of an automotive agricultural machine, a guide bush 2 being rotatably mounted on the shaft 1 and firmly connected with a clutch plate 4 by means of screws 3. Fastened to the clutch plate 4 on one side is a shiftable two-disc dry clutch 5, which according to its setting transmits or interrupts the torque to the input shaft 1. An undisplaceable V-belt pulley half 6 is fastened by means of screws 7 at the other side of the clutch plate 4. An oppositely disposed V-belt pulley half 8 is displaceable in axial direction and sides by its hub 9 on the guide bush 2. A slotted plate spring 10 bears against a disc 11 screwed to the guide bush 2 and transmits its relatively small spring force by means of a support ring 12 to the pulley half 8. As a result, the wide V-belt 13 is biassed between the two pulley halves 6 and 8.

Presser equipment, dependent on torque and gearing, for the V-belt 13 consists of two presser rings 14 and 15, which are associated with the pulley halves 6 and 8 and which are articulatedly connected together by two obliquely arranged rigid tie rods 16, and of respective pairs of entraining pins 17 and 18 which are fastened to the rings 14 and 15 rigidly and parallelly to the shaft 1. The pins engage in oppositely disposed openings 19 and 20 with abutment surfaces 21, 22, 23 and 24 at both sides in the pulley halves 6 and 8 and thereby stand in effective connection with these. The ring 14 is arranged between the clutch plate 4 and the fixed pulley half 6 and is centred with play on the hub 9 of the displaceable pulley half 8. The other ring 15 is mounted between the pulley half 8 and the plate spring 10 and is also centred with play on the hub 9.

A securing ring 25 limits the axial movability of the ring 15 relative to the pulley half 8. Through this arrangement of the rings 14 and 15 and the tie rods 16, only a very small axial constructional space is required. The two rings 14 and 15 have the same construction so that rational production is possible. The tie rods 16 are mounted in the rings 14 and 15 in ball joints consisting of balls 26 and 27 and bearing shells 28 and 29. For the reception of the bearing shells 28 and 29, the rings 14 and 15 each have two oppositely disposed, stepped bores 30. The tie rods 16 are provided with threads at both end regions. The balls 26 and 27 have a threaded bore for threaded and adjustable coupling with the tie rods 16. The tie rods 16 are secured in the balls 26 against unintended adjustment by lock-nuts 31. The bearings of the tie rods 16 in the rings 14 and 15 as well as the lengths of the tie rods 16 are chosen so that the tie rods 16 assume such a bearing position that the axial force component in all regulating settings of the V-belt transmission is in such a ratio to the instantaneous torque that an optimum belt tension is always present. Passages 32 and 33, in the form of elongate holes, are present in the pulley halves 6 and 8 for the passage of the tie rods 16. The openings 19 and 20 in the pulley halves 6 and 8 are so arranged that an entraining pin 17 of the ring 14 and an entraining pin 18 of the ring 15 project together into the same opening. The openings 19 and 20 are bounded in tangential direction by abutment surfaces 21, 22, 23 and 24, the radius of curvature of which is adapted to the diameter of the entraining pins

17 and 18.

In accordance with the particular operational state, the entraining pins 17 and 18 rest against two of the abutment surfaces 21, 22, 23 and 24 and thus form a mechanical rotational connection between the pulley halves 6 and 8 and the rings 14 and 15. During the principal operational state (travel with driving engine), the torque flow illustrated in Figs. 3 and 4 is present. In that case, the pins 17 rest against the abutment surfaces 21 and the pins 18 at the abutment surfaces 24. The arising force is transmitted to the pins 17 and 18 near the clamping zone. No sliding movement takes place between the abutment surfaces 21 and 24 and the pins 17 and 18 during the regulating operations of the V-belt transmission.

In the auxiliary operational state (travel with braking engine during retardation of the travel speed or during travel down a slope) with a small torque requirement, the torque flow illustrated in Figs. 5 and 6 is present. In this state, the pins 17 rest against the surfaces 23 and the pins 18 against the surfaces 22. The forces, which are lower in this operational state, are introduced at a greater spacing from the clamping zone. A sliding movement, which is without substantial significance due to the low loading over a small operating time, takes place at the surfaces 22 and 23 during the regulating operation. With more strongly dimensioned pins 17 and 18 and abutment surfaces 22 and 23, torque of the same magnitude can if desired be transmitted in both directions.

In use, the transmission of the rotational movement from the drive pulley to the take-off pulley of the V-belt transmission takes place by way of the V-belt 13.

The V-belt 13 biassed by the plate spring 10 transmits the driving force in about equal parts to the two pulley halves 6 and 8. The driving force component is transmitted by the non-displaceable pulley half 6 by way of the clutch plate 4 and the dry clutch 5 to the input shaft 1. The displaceable pulley half 8 is rotated by the driving force. The ring 15 is entrained by the pins 17 and 18 and the ring 14 by the tie rods 16 until it bears by way of the pin 17 against the pulley half 6. The driving force component from the pulley half 8 is thus transmitted by way of the ring 15, the tie rods 16, the ring 14 and the pulley half 6 also by way of the dry clutch 5 to the input shaft 1. The obliquely extending tie rods 16 are so arranged that, in dependence on their angular setting and their spacing from the longitudinal axis of the shaft 1, they produce an axial force component which presses the pulley halves 6 and 8 proportionally to the instantaneous torque and additionally to the force of the plate spring 10 against the flanks of the V-belt 13. Since, on a change of the regulating position, the angular position and the radial spacing of the tie rods 16 from the longitudinal axis of the input shaft 1 also vary, a different ratio of the axial force component to the torque also results and the presser equipment in dependence on torque operates also in dependence on the regulating position of the Vbelt transmission. The characteristic of the axial force in dependence on torque and regulating position can be adapted through variation of the length and position of the tie rods 16 to the most favourable operational conditions for an optimum V-belt life or highest power transmission.

On initiation of an oppositely directed driving force (retardation of the travel speed or travel on downward gradient), the resettable pulley half 8 rotates in the direction of the initiated driving force. In that case, the ring 14 is entrained by way of the pins 17 and 18 and the ring 15 by way of the tie rods 16 and the pulley half 8 until the ring 15 connects by way of the pins 17 and 18 with the pulley half 6. In this state, the driving force component of the pulley half 8 is transmitted by way of the ring 14, the tie rods 16, the ring 15, the pulley half 6 and the clutch 5 to the shaft 1. The tie rods 16 are thereby again stressed in tension so that the resulting axial force component has the same force direction F as in the principal operational state and can again be utilised for reinforcement of the tension of the V-belt 13.

CLAIMS

1. A V-belt pulley assembly comprising two relatively movable pulley halves defining a groove therebetween for a V-belt, and means for exerting on the pulley halves a torque-dependent force tending to axially displace the pulley halves relative to each other, the force-exerting means comprising a respective presser ring connected to each pulley half to be rotatable relative thereto but secure against axial displacement relative thereto, at least two tie rods so pivotably connected to and intercoupling the rings as to translate relative rotation thereof into relative axial displacement of the rings and of the pulley halves, and a respective pair of entraining pins which are rigidly connected to each ring to extend parallel to the axis of the pulley halves, the pins extending in elongate openings in the pulley halves and the openings being bounded by abutment surface portions engageable by the pins.

2. An assembly as claimed in claim 1, wherein the elongate openings are each arranged to receive one of the pins connected to one ring and one of the pins connected to the other ring.

3. An assembly as claimed in either claim 1 or claim 2, wherein the pins are arranged to mechanically intercouple the pulley halves for rotation with each other.

4. An assembly as claimed in any one of

the preceding claims, wherein the rings are of substantially the same construction.

5. An assembly as claimed in any one of the preceding claims, wherein each of the tie rods is provided at each end portion with a thread, a ball of a respective ball-and-socket coupling being threadably mounted on each threaded end portion of each tie rod.

6. A V-belt pulley assembly substantially as hereinbefore described with reference to the accompanying drawings.

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US-CL-CURRENT: **474/13**

ABSTRACT:

CHG DATE=19990617 STATUS=O> A V-belt pulley assembly comprises two pulley halves (6, 8) for a continuously variable V-belt transmission in which the pulley halves are pressed against the belt in dependence on torque and gearing. A respective presser ring (14, 15) is associated with each of the pulley halves (6, 8) and is connected to that pulley half to be fixed in axial direction and rotatable. The two rings (14, 15) are articulatedly connected together by way of two or more tie rods (16). Two entraining pins (17, 18), which are fastened rigidly and parallelly to an input shaft (1) of the assembly, are arranged at each of the rings. Elongate openings (19, 20) with abutment surfaces at both ends for the free end portions of the entraining pins are arranged in regions of the pulley halves opposite the pins. The arrangement allows the rods (16) to generate a force on the belt in both directions of rotation. <IMAGE>

---------- KWIC ---------

Current US Cross Reference Classification - CCXR (1):
474/13